Deep-C Consortium

Chronicles

Living in the Dark

Without access to sunlight, deepwater corals have different adaptations than their shallow-water counterparts. While shallow-water corals obtain most of their food from photosynthetic algae (called zooxanthellae) that live in their tissues, the deep-sea corals live in the dark and cannot support zooxanthellae, so they are suspension feeders that only capture organic matter and plankton. Want to know more? Read our "Deepwater Corals Fact Sheet" on Deep-C's website.

Deep-C's Summer 2013 Interns
An Experiment in Matchmaking!

This year, the Deep-C Consortium introduced a flexible internship program aimed at carefully matching undergraduate students, graduate students, and teachers with hands-on research opportunities at one of our member institutions. And the experiment appears to be going well!

Scientists involved in Deep-C research and willing to mentor were encouraged to offer an opportunity geared toward teachers and students interested in STEM (Science, Technology, Engineering or Mathematics) fields. The duration, format, and focus of each internship was closely tailored to meet actual project needs, ensuring that research experiences would be beneficial to the scientists and interns alike.

"We advertised the internships to educator and student groups interested in these type of hands-on learning opportunities," explains Meredith Field, Assistant in Research and Education and coordinator of the Deep-C Internship Program. "As a result, we were able to match 12 individuals to Deep-C scientists: 10 are interning over the current semester and two will intern in the fall."

The 2013 interns have been blogging about their individual experiences, which have ranged from conducting laboratory experiments to field work (including research cruises in the Gulf of Mexico and on-shore expeditions to collect oil spill samples along Gulf Coast beaches). And they have contributed nearly 50 posts to date on the Deep-C web blog!

We asked some of our interns about their experiences thus far. Below are their responses.

What advice have you received from your mentor that has been particularly helpful?

"Basically, I'm learning more than typical lab techniques; I'm learning how to succeed in the biological field."
— Chelsea McCurry, a junior undergraduate attending and interning at the University of West Florida

"It helps me stay positive and confident when Patrick reminds me to do what I can with what I have."
— Lauren Reilly, senior undergraduate attending and interning at the University of South Florida

"I spoke with my mentor... we discussed my future goals and I got some valuable insight into the job markets that fit my interests."
— Taylor Shropshire, senior undergraduate attending North Carolina State University and interning at Florida State University

What advice can you give to future interns?

"Break your project into smaller, more manageable problems, and then approach those one at a time."
— Jon Ubnoske, Ph.D student attending and interning at Florida State University

"Just work hard and be yourself, and you are bound to get on very well here."
— Becca Keenan, graduate student attending the University of Southampton (U.K) and interning at Florida State University

Public TV airs amazing episode on "Creatures of the Deep"

WPBT 2 — In the cold, deep waters of the Gulf of Mexico, little-known animals spend their entire lives in near darkness, far removed from our human world. Until now, little research has been conducted on these creatures of the deep, keeping much of their lives a mystery. Now, scientists from the Deep-C Consortium conduct regular research in the area. You can watch this episode of CHANGING SEAS on the WPBT 2 website or at http://video.wpbt2.org/

Gulf of Mexico Public Opinion Survey
Understanding the perceptions and information Florida residents have about the Gulf

Editor's Note: Becca Keenan is a graduate student studying Marine Science Policy and Law at the National Oceanography Centre, in Southampton, UK. An important aspect of her master's program is her Deep-C internship at Florida State University. Becca agreed to share a little bit about her thesis project and outreach activities before heading back "across the pond."

By Becca Keenan
Deep-C Summer Intern

As part of my Deep-C internship and Master's thesis, I am examining the perceptions and information Florida residents have about the 2010 Deepwater Horizon oil spill, the Gulf of Mexico environment, and the scientific research taking place in the region. My ultimate goal is to help develop effective strategies for communicating in ways that engage and inform public dialogue. But in order to do so, more needs to be known about what members of the public are currently aware of (or believe) when it comes to the oil spill and the Gulf of Mexico.

Surveying Public Opinion

In order to gauge public interest and understanding of issues related to the oil spill and the Gulf, I have constructed a public opinion survey. The information I get from survey responses will help guide Deep-C education efforts moving forward.

If you are reading this article and would be willing to take a few moments to help inform our efforts, please complete the online survey at:
https://www.surveymonkey.com/s/GulfofMexico-PublicOpinionSurvey

"*Love the Gulf*" Campaign

Another aspect of my internship has been to be involved in the development of a public awareness campaign that will alert the general population of the Gulf region about new and significant scientific findings by Deep-C researchers and others. I was excited to contribute my artistic abilities to the process and designed several graphics now being used as part of the Deep-C *"Love the Gulf"* campaign. I couldn't resist bringing a British bulldog spirit to the campaign with one of our slogans *"Keep Calm and Love the Gulf."*

You can find these materials (posters, facts sheets, and even a screen saver) in the Education and Outreach section Deep-C's website (*www.deep-c.org*)**.**

Top: To date, we have surveyed more than 100 Florida residents. Bottom: Some of our "Love the Gulf" campaign items are being produces as stickers, and posters.

Internship Experiences at Deep-C

"If you have questions, ask them. The whole point of the internship is to learn something."
— Dana Fields, a high school science teacher interning at Florida State University

"This is an amazing opportunity to work at the cutting edge of research. Be active in the lab and learn all you can."
— Curtis Okolovitch, a junior undergraduate attending Florida State University and interning at Georgia Tech

What mistakes have you made in your research?

While filtering samples, I forgot to dump the water container and it caused water to go into the pump filter!
— Charnelle Bland, senior undergraduate attending Emory University and interning at Valdosta State University

### *Any "eureka!" moments during your internship?*

We realized after our first growth experiment that the pH of the media was decreasing over time, so we started buffering the media and saw a huge increase in bacterial growth.
— Kala Marks, recent graduate of Florida State University interning at Georgia Tech

I thought I was decent at time management, but was in for a shock when I started research.
— Chrissie Rakowski, graduate student attending and interning at Florida State University
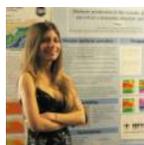
For more information about the Deep-C Flexible Internship Program visit www.deep-c.org/internships.

Note to educators: If you are in need of a small supply of the stickers or posters, please feel free to contact us.

Study identifies Deepwater Horizon debris as likely source of new Gulf of Mexico oil sheens

From July 16, 2013 media release from Woods Hole Oceanographic Institution (Photos courtesy of Chris Reddy)

A chemical analysis of oil sheens found floating recently at the ocean's surface near the site of the *Deepwater Horizon* disaster indicates that the source is pockets of oil trapped within the wreckage of the sunken rig. Both the Macondo well and natural oil seeps common to the Gulf of Mexico were confidently ruled out.

Researchers from Woods Hole Oceanographic Institution (WHOI) and the University of California, Santa Barbara (UCSB) used a recently-patented method to fingerprint the chemical makeup of the sheens and to estimate the location of the source based on the extent to which gasoline-like compounds evaporated from the oil sheens. The study was published in *Environmental Science & Technology*.

The oil sheens were first reported to the United States Coast Guard by BP in mid-September 2012, raising public concern that the Macondo well, which was capped in July 2010, might be leaking.

"It was important to determine where the oil was coming from because of the environmental and legal concerns around these sheens. First, the public needed to be certain the leak was not coming from the Macondo well, but beyond that we needed to know the source of these sheens and how much oil is supplying them so we could define the magnitude of the problem," said WHOI chemist Chris Reddy.

Co-authors Chris Reddy, foreground, and Dave Valentine during an overflight of the affected area in January 2013.

When oil sheens appear on the ocean surface, how do researchers determine where the oil is coming from? Every oil sample contains chemical clues pointing to the reservoir it came from, allowing scientists to compare it to other samples to determine if they share a common source. The lead scientists Chris Reddy (WHOI) and Dave Valentine (UCSB) were aptly prepared to investigate these sheens. They have worked on the *Deepwater Horizon* for much of the last three years, investigating a wide range of problems from the composition of the oil, detection of subsurface plumes, the biodegradation of the oil, the fate of the dispersants, and the chemical transition from floating oil slicks to sunken tar balls.

This research analyzed 14 sheen samples they skimmed from the sea surface during two trips to the Gulf of Mexico. Using comprehensive two-dimensional gas chromatography (GCxGC), a technique developed in Reddy's lab, the researchers first confirmed the sheens contained oil from the Macondo well. But the sheen samples also contained trace amounts of "olefins"—industrial chemicals that are used in drilling operations—compounds that were absent from the sample taken directly from the Macondo well. The presence of "olefins" provided a fingerprint for the sheens that the authors could compare to the library of samples they had analyzed over the past three years.

The "olefins" are not found in crude oil and their uniform distribution in the sheens indicated that the Macondo well was unlikely to be the source. The team surmised that the sheens must be coming from equipment exposed to olefins during drilling operations. Reddy's lab holds a patent on measuring olefins in crude oils.

"The occurrence of these man-made olefins in all of our sheen samples points to a single main source which contains both Macondo oil and lesser amounts of the drilling fluids that harbor

Surface sheen seen in October 2012 near the site of the Deepwater Horizon disaster. The oil has "dampened" the sea surface, smoothing its surface expression. The research team looked for these dampened areas rather than the sheens themselves as sunlight made the sheens difficult to see at boat level.

the olefins," said Valentine. "This pointed us to the wreckage of the rig, which was known to have both, as the most likely source for the sheens."

It also meant the olefins could be used by the team as a fingerprint in the search for the source of the leak.

The research team compared the sheen samples to other field samples, some of which they expected would contain olefins and some they thought would not. The reference samples included two pieces of debris from the *Deepwater Horizon,* found floating in early May 2010, as well as oil collected by BP in October 2012 during an inspection of the 80-ton cofferdam that had been abandoned at the sea floor after its use in a failed attempt to cover the Macondo well in 2010.

The team's GCxGC analysis of BP's cofferdam samples definitively showed the cofferdam was not the sole source of the leak – there were no olefins present. Prior to the analysis, the cofferdam had become the prime suspect as the source when BP found small amounts of oil leaking from the top of the cofferdam. BP acquired oil samples from this leak point before sealing the leak, thinking they had resolved the problem. However, the sheens on the sea surface

persisted, and the lack of olefins pointed to another source entirely.

When Reddy and Valentine compared the chemical makeup of the sheens with *Deepwater Horizon* debris found floating in 2010, they found a match. That debris, which came from the rig itself, was coated with oil and contaminated with drilling mud olefins.

"The ability to fingerprint synthetic hydrocarbons allowed us to crack this case. We were able to exclude a number of suspects and match the olefin fingerprint in the new oil slicks to that of the wreckage from the sunken rig," said Valentine.

To explain how the oil might be trapped and released from the wreckage, the scientists point out that when the *Deepwater Horizon* rig sank, it was holding tanks containing hundreds of barrels of a mixture of drilling mud and oil. Over time, corrosive seawater can create small holes for oil to slowly escape to the surface. The researchers suspect that the containers on the *Deepwater Horizon* rig holding entrapped oil may be the source of the recent oil sheen.

To read the entire release and other information about WHOI 's oil spill research, go to http://m.whoi.edu/page.do?pid=53004&tid=3622&cid=171549

Deep-C Consortium

Studying deep sea to coastal communities in the northeastern Gulf of Mexico

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The Deep-C Consortium is investigating the environmental consequences of petroleum hydrocarbon (oil) on living marine resources and ecosystem health in the northeastern Gulf of Mexico. Consortium members seek to increase understanding of the fundamental physical, chemical, and biological connections between the deep sea, continental slope, and coastal waters and their linkages to critical habitats and ecological functions.

More than 100 scientists and students at 10 academic and research institutions in the United States and Norway are participating in Deep-C. Activities include mapping the sea floor; analyzing water and sediment samples; studying how oil-related toxins may affect wildlife; and determining how currents and other ocean processes transport oil.

Data is collected by hand, boat, plane, and satellite and is analyzed and used in model studies to support improved responses to possible future oil spills. Through computer simulations of possible oil spill scenarios, Deep-C is producing projections of changes in ecosystem services that can support enhanced decision making and forecasting of potential socioeconomic outcomes.

Deep-C seeks to engage students, policy makers, and the general public in the process of scientific discovery and to encourage a sense of stewardship for the Gulf. Our outreach efforts include experiential internships; educational workshops; special events; multimedia production; and social networking.

Images from the Field
Summer 2013

1) Dr. Ian MacDonald (FSU) works on the MILET platform, a "toolsled" constructed to hold equipment that will transmit images and data from the sea floor. 2) Visitors from Bolivia, Chile, Colombia, Dominican Republic, Guatemala, El Salvador, Mexico, Paraguay, and Peru meet with Deep-C scientists at UWF to discuss the state of marine life after the oil spill. 3) Dr. Stan Locker (USF) and team readies a side-scanning sonar towfish for deployment. 4) Intern Charnelle Bland filters chlorophyll samples collected on a June research cruise. 5) Dr. David Hollander (USF) gives a talk at a recent COSEE National Network Meeting. Look at that backdrop!! 6) Ben Frieberg (guest student at WHOI) moves a sediment filled rock scraping into a sample jar on Dauphin Island. 7) Be sure to "like" the Deep-C Facebook page.